

EPA WORLD TRADE CENTER EXPERT TECHNICAL REVIEW PANEL

ON THE ISSUE OF MICROVAC SAMPLING

comments of

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May 3, 2004

I welcome the beginning of a discussion among panel members on the efficacy of utilizing microvacuum (and other) collection methods as part a comprehensive indoor testing effort in post-9/11 Lower Manhattan.

Krish is certainly correct in pointing out the regulatory and scientific limitations of ASTM D5755-95. I referred to some of these limitations in my comments of April 20, 2004. Most importantly, although a finding of an elevated asbestos concentration in settled dust indicates the presence of asbestos fibers which have been released and which may be available for resuspension, we have only a limited understanding of the relationship between surface load and the potential for resuspension, exposure, and health risk.

In my opinion, however, these limitations do not disqualify microvac collection methods from a testing program, when used appropriately. See the following excerpted remarks from various experts, including citations from EPA and ASTM:

Uses of ASTM D5755-9

To completely evaluate conditions within facilities containing asbestos materials, sampling dust to determine its asbestos content may be necessary. The evaluation of dust may be helpful during the initial inspections to determine if ACM (asbestos-containing material) has released asbestos fibers into the building environment. Settled dust samples will provide information about past releases, unlike air samples, which can only provide information about air concentrations during the sampling period. EPA does not recommend the use of air sampling for this type of material condition evaluation as it provides only a "snapshot in time" of building conditions.²

¹ New York Committee for Occupational Safety and Health (NYCOSH).

² Hatfield, Richard. Settled Dust Sampling and Analysis - Determining Levels of Asbestos Contamination. unpublished manuscript, undated, p. 2 (personal communication, September 5, 2002).

The primary use of this method has been to determine if asbestos-containing materials (ACM) within buildings have released asbestos fibers and contaminated surfaces and/or materials in buildings. Additionally, the dust sample results yield an indication of the relative concentration of asbestos detected on the various surfaces sampled... Sampling dust from sites which are subjected to disturbance will also provide insight as to the potential for re-entrainment of any asbestos detected in the dust.³

Maybe more important to an investigator than the absolute quantity of asbestos present in the dust is the location of the asbestos contaminated dust and its likelihood of disturbance. In many past studies, the reentrainment of asbestos-laden dust from housekeeping, maintenance, and renovation activities has been demonstrated.⁴

Asbestos surface dust sampling has gained wide acceptance as a tool to evaluate exposure from in-place asbestos-containing materials. The primary purpose of conducting such tests is to estimate the concentration of asbestos structures on surfaces. This information, coupled with the investigator's knowledge of building occupancy, activities, ventilation, and surfaces is valuable to reasonably anticipate when exposures to airborne asbestos may occur... In the past few years the method of choice has been the microvacuum technique followed by analysis with transmission electron microscopy (TEM).⁵

In 1997, a telephone survey of TEM laboratories... showed that the microvacuum asbestos dust procedure in the form of ASTM D5755 was routinely applied across the country. Of forty eight TEM laboratories (not including multiple sites belonging to one company) surveyed from the National Institute of Standards and Technology (NIST) TEM asbestos laboratory list, thirty five reported using ASTM D5755. Most of the laboratories (30 of 35) indicated that their clients used it for assessment of asbestos in buildings; some (9 of 30) indicated that their clients used the results for clearance activities.⁶

Passive collection techniques and active collection techniques (microvac and wipe) are both necessary to determine current asbestos accumulation and historical asbestos

³ Hatfield, Richard. Settled Dust Sampling and Analysis - Determining Levels of Asbestos Contamination. unpublished manuscript, undated, pp. 4 - 5 (personal communication, September 5, 2002).

⁴ Hatfield, R.L., Krewer, A., and Longo, W.E. "A Study of the Reproducibility of the Micro-Vac Technique as a Tool for the Assessment of Surface Contamination in Buildings with Asbestos-Containing Materials" in Beard, M.E. and Rook, H.L., Advances in Environmental Measurement Methods for Asbestos, ASTM STP 1342, American Society for Testing and Materials, Philadelphia, 2000, p. 311.

⁵ Ewing, William. "Further Observations of Settled Asbestos Dust in Buildings" in Beard, M.E. and Rook, H.L., Advances in Environmental Measurement Methods for Asbestos, ASTM STP 1342, American Society for Testing and Materials, Philadelphia, 2000, pp. 323 -324.

⁶ Millette, James. Mount, Michael. "Applications of the ASTM Asbestos in Dust Method D5755" in Beard, M.E. and Rook, H.L., Advances in Environmental Measurement Methods for Asbestos, ASTM STP 1342, American Society for Testing and Materials, Philadelphia, 2000, p. 367.

accumulation. Microvac samples tend to more accurately reflect potential re-entrainable asbestos, wipe samples tend to more accurately reflect all accumulated asbestos, and passive samples provide a measure of current accumulation rates. Air sampling provides a snapshot in time of airborne fiber levels... A comprehensive, effective approach to settled dust analysis would utilize more than one method to determine historical accumulation, loose versus bound dust, source location, and current accumulation.⁷

EPA and ASTM D5755-95

In 1989 a meeting sponsored by the United States Environmental Protection Agency was held in an effort to evaluate and standardize a surface dust sampling techniques for assessment of asbestos contamination... The resulting dust sampling and analysis procedure which was agreed upon is, in essence, the same microvacuuming methodology which we have been using for several years. Since that time Dr. Longo has drafted a similar method for the American Society of Testing and Materials (ASTM). The methods differ slightly in the TEM sample preparation and analysis procedures, but the microvacuuming collection methods are essentially the same. This ASTM method was published as D5755-95... in 1995.⁸

Asbestos surface dust sampling and analysis has gained increased usage by industrial hygienists, engineers and others. Early attempts at sampling asbestos dust consisted of collecting unknown amounts of dust and debris... Recently a more sophisticated surface dust sampling and analysis method has evolved using transmission electron microscopy (TEM). The method was refined in a draft document by the USEPA and ultimately published by ASTM as standard method D5755-95 in October 1995.⁹

Greater interest in dust analysis was generated in 1989 after the USEPA developed a draft method for evaluating surface dust... This method was published after further refinement in October 1995 by the American Society for Testing and Materials (ASTM) as their D5755-95 Standard Method entitled, "Microvacuum Sampling and Indirect Analysis of Dust of Transmission Electron Microscopy for Asbestos Number Concentrations." ...This has become the method of choice for most evaluations of

⁷ Crankshaw, Owen. Perkins, Robert. Beard, Michael. "An Overview of Settled Dust Analytical Methods and Their Relative Effectiveness" in Beard, M.E. and Rook, H.L., Advances in Environmental Measurement Methods for Asbestos, ASTM STP 1342, American Society for Testing and Materials, Philadelphia, 2000, p. 364 - 365.

⁸ Hatfield, Richard. Settled Dust Sampling and Analysis - Determining Levels of Asbestos Contamination. unpublished manuscript, undated, pp. 1 - 2 (personal communication, September 5, 2002).

⁹ Ewing, William. Dawson, Tod. Alber, George. "Observations of Settled Asbestos Dust in Buildings" EIA Technical Journal, Summer 1996, p. 13.

asbestos containing dust.¹⁰

EPA used microvac collection for asbestos (and lead) in its WTC Residential Confirmation Cleaning Study

Pre-cleaning sampling also included the collection of micro vacuum samples from up to six porous surface areas (e.g., carpets, furniture fabric) in twelve of the thirteen residential units, and both commercial units included in the study... The micro vacuum samples were analyzed for lead and for asbestos (TEM).¹¹

Dust vs. bulk samples

EPA's definition of ACBM (asbestos-containing building material) "greater than 1% asbestos" was intended for building materials, not for dust containing loose asbestos fibers. EPA chose this level because it was their belief that (sic) buildings materials were not manufactured with less than 1% asbestos as an added ingredient. The 1% level was not intended to be used as a contamination concentration... The difference in asbestos weight percent and fiber count per unit area can also clearly be seen in the following example. If an area in a building has one million asbestos structures per square centimeter on its surface, clearly there would be concern for the asbestos contamination. If, in addition to the one million asbestos fibers per square centimeter one added enough mass of dust or dirt to yield a total asbestos weight percentage of less than one percent, has the concern for asbestos disappeared? No, the additional material has made no difference in our concern for the asbestos contamination. The potential for exposure to airborne asbestos during a disturbance to these materials still exists.¹²

Porous surfaces

Assessing asbestos fiber contamination in a carpet is complicated by the nature of the carpeting - because of the pile's rough surface and thickness, samples cannot be collected directly from carpet for analysis by TEM... The micro-vacuuming technique gives an index of the readily releasable asbestos fiber from the carpet surface... For those fibers which can be readily reentrained into the air from the carpet surface during cleanup activities, the microvacuuming procedure may be ... appropriate. This is

¹⁰ Hatfield, R.L., Krewer, A., and Longo, W.E. "A Study of the Reproducibility of the Micro-Vac Technique as a Tool for the Assessment of Surface Contamination in Buildings with Asbestos-Containing Materials" in Beard, M.E. and Rook, H.L., Advances in Environmental Measurement Methods for Asbestos, ASTM STP 1342, American Society for Testing and Materials, Philadelphia, 2000, p. 303.

¹¹ United States Environmental Protection Agency, Region 2. Interim Final WTC Residential Confirmation Cleaning Study, Volume 1. May 2003, p. 28.

¹² Hatfield, Richard. Settled Dust Sampling and Analysis - Determining Levels of Asbestos Contamination. unpublished manuscript, undated, pp. 8 - 9 (personal communication, September 5, 2002).

reasonable considering that the microvacuuming procedure collects fibers from the top layer of the carpet...¹³

Precision of microvac results

Where side-by-side sampling was conducted for microvac and wipe samples, the methods showed good precision. Wipe sampling appears to be a more effective collection technique than microvac sampling on surfaces containing high asbestos concentrations, but on cleaner surfaces, the microvac and wipe sampling techniques appear to be relatively equivalent... Results from the microvacuum structure count samples indicate that the method adequately tracks the concentration of asbestos in the dust and that variability is quite low. When the concentration of asbestos was increased ten-fold, as from 0.1% to 1% or from 1% to 10%, the number of structures per area increased proportionately... Intersample variability was typically less than +/- 15%.¹⁴

Benchmarks

Typical asbestos concentration values in... surface dust as determined using the microvac technique were published for a variety of sites containing ACM. A wide range was evident, from 6.5 s/cm² to over 4.3 million s/cm², averaging near 1,000 s/cm² (one million s/ft²)... Typical carpet dust values for the microvac method ranged from 8.6 s/cm² to 2.2 million s/cm², averaging about 1,000 s/cm². Although limited, some settled dust data exist for samples taken from buildings which were constructed without ACMs. Microvac dust samples from three government buildings which did not have ACMs in the state of Maryland showed levels of asbestos fibers less than 200 s/cm². Surface samples collected in a western state in buildings with no ACMs were below the microvac technique usual detection limit of about 160 s/cm². As might be expected, areas that are normally cleaned on a routine basis are generally lower than areas where dust accumulates undisturbed over a period of time... Microvac samples collected of dust resulting from a breach in containment of an asbestos abatement area into a store which had been cleaned the previous day showed levels of asbestos of about 100,000 s/cm². Levels of asbestos in layers of dust collected by microvac from the tops of ceiling tiles and light fixtures below asbestos-containing fireproofing have in some cases been

¹³ Millette, James. Clark, P.J. Brackett, Kim. Wheelles, R.K. "Methods for the Analysis of Carpet Samples for Asbestos" in Millette, James, and Hays, Steve. Settled Asbestos Dust - Sampling and Analysis. Lewis Publishers, CRC Press, 1994, pp. 141 - 148.

¹⁴ Crankshaw, Owen. Perkins, Robert. Beard, Michael. "An Overview of Settled Dust Analytical Methods and Their Relative Effectiveness" in Beard, M.E. and Rook, H.L., Advances in Environmental Measurement Methods for Asbestos, ASTM STP 1342, American Society for Testing and Materials, Philadelphia, 2000, p. 360 - 362.

over 1 billion s/cm².¹⁵

It is apparent that there is no single number that can be referenced to delineate when a surface is “clean.” It appears that concentrations of asbestos dust less than 1,000 s/cm² are unlikely to result in elevated exposures. At the opposite extreme, values in excess of 100,000 s/cm² should be a cause for concern. Values between these two extremes require the investigator to carefully consider possible exposure scenarios, including reentrainment mechanisms and the exposed population.¹⁶

Based on the authors’ experience, levels of asbestos in settled dust as determined by the microvac technique are considered low if less than 1,000 s/cm². Levels above 10,000 s/cm² are generally above background. Levels above 100,000 s/cm² are considered high and in the range of a significant accidental release from an abatement site.¹⁷

¹⁵ Millette, James. Hays, Steve. “Data: Levels of Asbestos in Dust” in Settled Asbestos Dust - Sampling and Analysis. Lewis Publishers, CRC Press, 1994, pp. 49 - 50.

¹⁶ Ewing, William. Dawson, Tod. Alber, George. “Observations of Settled Asbestos Dust in Buildings.” EIA Technical Journal, Summer 1996, p. 17.

¹⁷ Millette, James. Hays, Steve. “Data: Levels of Asbestos in Dust” in Settled Asbestos Dust - Sampling and Analysis. Lewis Publishers, CRC Press, 1994, p. 50.